THE GALILEO HIGH GAIN ANTENNA DEPLOYMENT ANOMALY

ABSTRACT TO THE 28TH AEROSPACE MECHANISMS SYMPOSIUM

Michael R. Johnson
Jet Propulsion Laboratory, California Institute of Technology
Pasadena, California

On April 11., 1991 at approximately 12:30 p.m., telemetry from the Galilee) Spacecraft indicated that the High Gain Antenna motors drew power for the entire eight minute antenna deployment sequence. This information indicated the antenna did not deploy properly. The subject of this paper will discuss the following two years of analysis, computer modeling, and testing of spare hardware that has led to our current understanding of the antenna shape and why the problem occurred. Also, a discussion of some of the recovery techniques will be included.

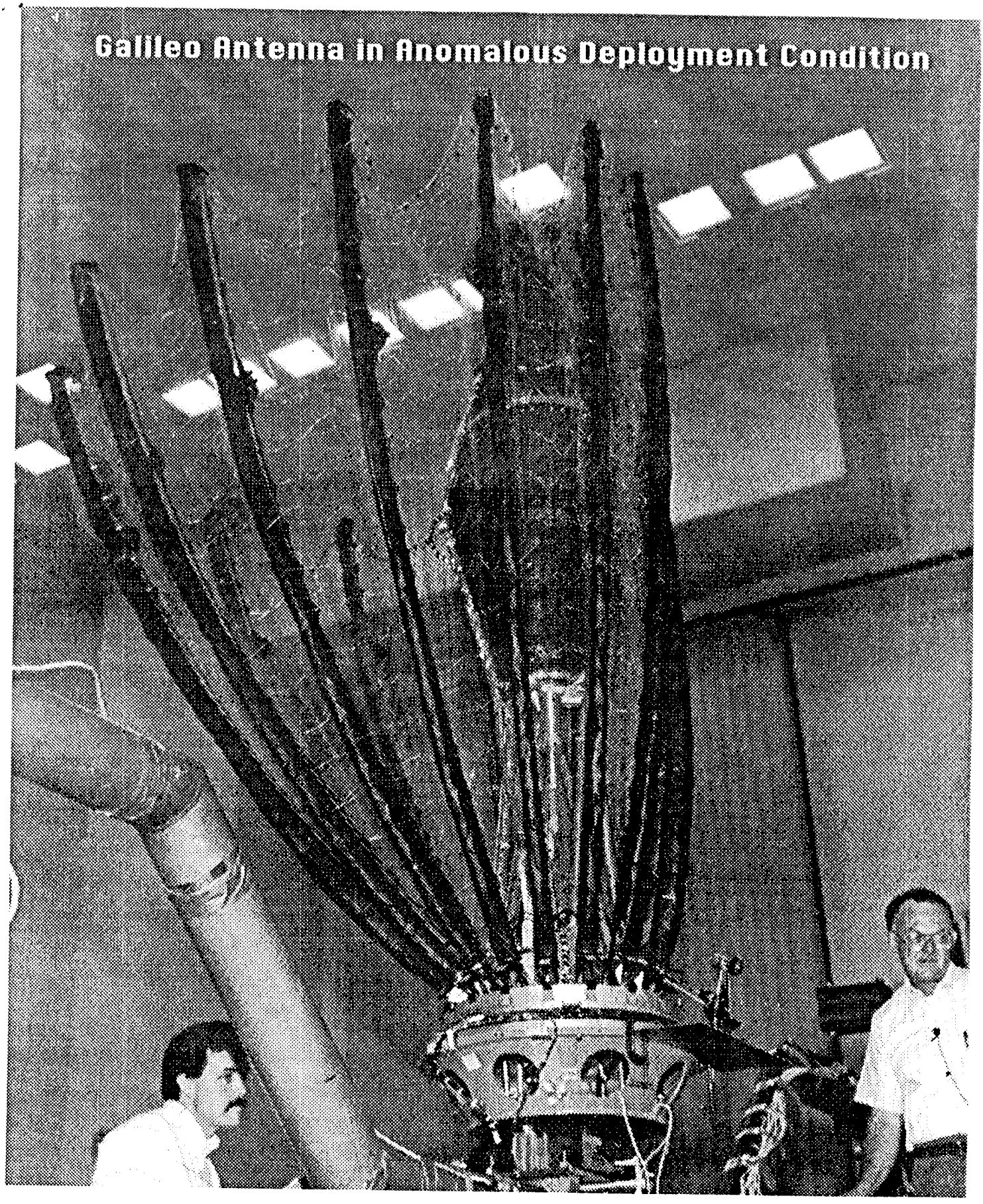
The first question answered during the investigation was what the antenna shape was. Four sources of telemetry from the spacecraft allowed conclusive determination of the antenna shape. This analysis was followed by tests that verified the analyses.

The mechanism that resulted in the final state of the antenna includes the improper selection and use of some materials and not accounting for a source of torque loss in the mechanical drive system under unusual loading conditions. The improper selection and use of some materials resulted in a failure mechanism that can't be detected when tested in an atmosphere. The torque loss source in the mechanical drive system led to a failure mode result that was totally different than the result from the failure mode analyses.

The lessons learned from this anomaly investigation include an understanding of the materials interaction and the efficiency changes in ballscrews with different types of load combinations.

Following the investigation, some recovery techniques were developed that took advantage of subtle differences in spring rate and moving inertia under certain frequency conditions. These techniques resulted in more than doubling the output torque of the Dual Drive Actuator driving the antenna.

At the time of the Symposium, all failure determination analyses will be complete and several recovery techniques will have been attempted. This will be the first presentation of the Galileo High Gain Antenna Deployment Anomaly that includes the final analysis results and recovery attempt results.


Galileo Antenna in Anomalous Deployment Condition